

14. A microwave processing apparatus according to claim 10, further comprising means for irradiating the substrate to be processed with optical energy.

16. A microwave processing apparatus according to claim 10, further comprising high frequency supply means connected to said support means.

18. A microwave processing apparatus according to claim 10, wherein said wave guide tube is provided therein with a second dielectric material which is different from said first dielectric material.

microwave introduction means utilizing an endless annular wave guide tube provided around said plasma generation chamber and provided with plural slots;

wherein an interior of said annular wave guide tube is filled with a second dielectric material which is the same as or different from said first dielectric material.

22. A microwave processing apparatus according to claim 50 21, wherein the magnetic field in the vicinity of the slots has a magnetic flux density approximately equal to 3.57×10^{-11} (T/Hz) times of a frequency of the microwave.

55 24. A microwave processing apparatus according to claim 19, further comprising means for irradiating the substrate to be processed with optical energy.

26. A microwave plasma processing method utilizing a microwave plasma processing apparatus comprising a plasma generation chamber of which periphery is separated from ambient air by a dielectric member; microwave introduction means utilizing an endless annular wave guide tube provided around said plasma generation chamber and provided with plural slots; a processing chamber connected to

$$L_s/\lambda_s = (2n+1)L_g/\lambda_g$$

27. A microwave processing method according to claim 26, wherein the plasma process is effected under application of a magnetic field.

29. A microwave processing method according to claim 26, comprising a step of placing said substrate on said substrate support means at a position distant from a generation area of said plasma.

31. A microwave processing method according to claim 30, wherein said optical energy includes ultraviolet light.

33. A microwave processing method according to claim 26, wherein a interior of said wave guide tube is filled with a first dielectric material.

35. A microwave processing method according to claim 26, wherein said plasma process is film forming.

36. A microwave processing method according to claim 26, wherein said plasma process is etching.

37. A microwave processing method according to claim 26, wherein said plasma process is ashing.

38. A microwave plasma processing method utilizing a microwave plasma processing apparatus comprising a plasma generation chamber of which periphery is separated from ambient air by a dielectric member; microwave introduction means utilizing a cylindrical endless annular wave guide tube provided around said plasma generation chamber and provided with plural slots; a processing chamber connected to said plasma generation chamber; support means for a substrate to be processed; provided in the processing chamber; gas introduction means for said plasma generation chamber and said processing chamber, and evacuation means for said plasma generation chamber and said processing chamber, adapted for effecting a plasma process by selecting a central radius R_g of said endless annular wave guide tube, a wavelength λ_g of the microwave in said endless annular wave guide tube, a central radius R_s of said dielectric member and a wavelength λ_s of the surface wave propagating in said dielectric member so as to substantially satisfy a relationship:

wherein n is 0 or a natural number.

40. A microwave processing method according to claim 39, wherein said magnetic field is so controlled that the magnetic field in a vicinity of the slots is at a magnetic flux density approximately equal to 3.57×10^{-11} (T/Hz) times of a frequency of the microwave.

15 42. A microwave processing method according to claim
38, wherein the plasma process is effected under irradiation
of the processed substrate with optical energy.

20 44. A microwave processing method according to claim 38, wherein the plasma process is effected by supplying high frequency to said support means.

46. A microwave processing method according to claim 38, wherein an interior of said wave guide tube is filled with a second dielectric material which is different from said first dielectric material.

48. A microwave processing method according to claim 38, wherein said plasma process is etching.

49. A microwave processing method according to claim 38, wherein said plasma process is ashing.

50. A microwave plasma processing method wherein a substrate is placed in a microwave plasma processing apparatus comprising a plasma generation chamber separated from ambient air by a first dielectric material; a processing chamber connected to the plasma generation chamber; means for supporting a substrate to be processed, to be placed in the processing chamber; microwave introduction means utilizing an endless annular wave guide tube provided around said plasma generation chamber and provided with plural slots; means for introducing gas for said plasma generation chamber and said processing chamber; and evacuation means for said plasma generation chamber and said processing chamber, wherein the interior of said annular wave guide tube is filled with a second dielectric material which is the same as or different from the first dielectric material, thereby effecting a plasma process.

51. A microwave processing method according to claim 50, wherein a ratio of the dielectric constants of said first and second dielectric materials is approximately equal to a reciprocal of a square of a ratio of circumferential lengths of said first and second dielectric materials.

52. A microwave processing method according to claim 50, wherein said plasma processing process is effected under application of a magnetic field.

53. A microwave processing method according to claim 52, wherein the magnetic field in a vicinity of the slots has a magnetic flux density approximately equal to 3.57×10^{-11} (T/Hz) times of a frequency of the microwave.

54. A microwave processing method according to claim 50, comprising a step of placing said substrate on said substrate support means at a position distant from a generation area of said plasma.

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57. A microwave processing method according to claim 50, wherein said plasma process is film forming.

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59. A microwave processing method according to claim
5 50, wherein said plasma process is ashing.

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